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FORMATION OF HEAT RESISTANT COATING LAYER

[TAINETSUSEI HIFUKUSOU NO KEISEIHOUHOU]

BABA HIDEKAZU

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INVENTOR(S)	(72):	BABA HIDEKAZU TAKEDA HIROMITSU SUZUKI TAKAO
APPLICANT(S)	(71):	TOSHIBA CORP
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SPECIFICATION

1. Title of the Invention

Formation of Heat Resistant Coating Layer

2. Patent Claims

Formation of a heat resistant coating layer which is characterized by improved corrosion resistance by making a surface of a ceramic layer dense by performing a laser irradiation treatment after processing a metallic bonding layer and a ceramic layer on a substrate in a method that coats on a heat resistant alloy substrate with a coating by a spray coating method with the objective of heat shielding, heat resistance and wear resistance.

3. Detailed Description of the Invention

(Field of the Invention)

The present invention pertains to the improvement of a coating layer for the required high temperature durability of heat resistant components that are used in a variety of hot devices.

(Prior Art and Problems to be Solved by the Invention)

Heat resistant alloys like Ni group or Co group alloys are used in heat resistant components. However, application is somewhat difficult due to the problem of brittleness which is must be considered for ceramic materials that are heated to high temperatures.

Therefore, methods wherein a heat resistant alloy is cooled while being used as a high temperature material exist, but the thermal efficiency decrease relative to the cooling is a problem. Currently, ceramic coatings that apply the low thermal conductivity of ceramics are also beginning to be viewed seriously.

The ceramic coatings have a ceramic with a low thermal conductivity coated on an existing heat resistant alloy, and are a method for heating shielding of a substrate alloy at high heat. Ceramics generally have small thermal expansion coefficients, therefore a ceramic layer can easily peel due to the ceramic layer and substrate thermal expansion difference. Thus, coating formation of a stabilized ZrO_2 type ceramic layer with a relatively small thermal expansion coefficient and small thermal conductivity was studied for imparting corrosion resistance, heat shielding and erosion resistance to Ni group alloys and Co group alloys. However, use as demanded was not obtained over long periods, which is a problem because the coating layer easily peels due to the heat cycle when heat resistance is imparted by the abovementioned ceramic coating. As a remedy for this, a so-called cement type mixture that is comprised of ZrO_2 and a metal is interposed between the substrate and the ceramic layer, and

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is designed for mitigating the thermal expansion coefficient difference, and is also studied for imparting the best wear resistance. In this way, improvement is possible to the extent that is due to a means like the material [illegible] and material

constitution of the coating layer, but corrosive gases, which are generated as combustion gases of petroleum coals and such, corrode the metallic bonding layers and substrates and the like as corrosive gas can penetrate by means of tiny cracks and pores and such that are present within the ceramic layer. Therefore, faults of the spray coat characteristics accompany [this,] like the metallic layer being damaged and the ceramic peeling being easily generated. Therefore, the strengths and faults of methods like the development of metallic bonding material with excellent corrosion resistance and pore sealing treatments of ceramic layers were studied, but adequate designs did not exist for satisfactory corrosion resistance, heat shielding and erosion resistance.

(Objective of the Invention)

This invention offers the formation of a heat resistant coating layer wherein a coating layer that is formed by spray coating is improved by obtaining corrosion resistance, heat shielding and wear resistance.

(Embodiment of the Invention)

The present invention has the formation of a coating layer with excellent corrosion resistance by making the surface of a ceramic dense by means of laser irradiation after establishing a metallic bonding layer and a ceramic layer on a substrate surface which is comprised of a heat resistant alloy of a predetermined shape.

First, a heat resistant alloy that is already known can be suitably selected as the heat resistant alloy for the present invention according to the application, and the use of a Ni group heat resistant alloy like IN738LC or IN939, or a Co group heat resistant alloy like X-40 or MAR-M509 is desirable during practical use.

Next, blasting of the surface of the heat resistant alloy is executed with Al_2O_3 or the like, and a metallic bonding layer and a ceramic layer are established. The metallic bonding layer plays the role of mitigating the thermal stress that occurs due to the thermal expansion coefficient difference between the substrate and the ceramic layer. Therefore, the thermal expansion coefficient of the metallic bonding layer is desired to have a value near that of the substrate and the ceramic layer.

The present invention takes into consideration not only the value of the thermal expansion coefficient, but also the high temperature properties; thus, [Nicrsly; corrected to:] NiCrAlY and [Cocrsly; corrected to:] CoCrAlY were used. ZrO_2-Y_2O_3 was used for the ceramic layer which has a small conductivity and a thermal expansion coefficient that is relatively close to [that of] the metal layer. A 100 µ metallic bonding layer was produced by plasma spraying, and a 300 µ ceramic layer was produced by spraying. Pores that are characteristic of spraying were present on the sprayed layers. These pores absorb negative influences as properties like corrosion resistant erosion but are effective surfaces for thermal shock. Further, the pores have excellent effectiveness for thermal shock to

an extent that is caused by the pores of a sprayed surface acting to mitigate the thermal stress that is generated by the heat cycle. Therefore, a constitution with a metallic bonding layer/ceramic layer with a thermal expansion difference was desired to have a ceramic layer such as [illegible] corrosive gas by pores of that extent being present. The present invention is a method of forming a dense layer without pores from spraying by laser irradiation of the surface of a ceramic layer after processing the metallic bonding layer and ceramic layer.

The erosion resistance is improved along with increasing the heat shielding and corrosion resistance by making the ceramic layer surface dense.

(Effect of the Invention)

The present invention can receive a heat cycle without metallic bonding layer damage as in prior [art]; therefore, the formation of a heat resistant coating layer is offered with the development of effects that protect from corrosive gases along with having stable heat shielding effects due to the bond between the metallic bonding layer and the ceramic layer being sound and with erosion resistant effects by making the ceramic layer surface dense. Therefore, [the present invention] can be widely applied to fields that use [untranslatable: teishitsunetsuzai; probably a typographical error for: low heat materials].

(Example of the Invention)

Below, an example of this invention is described by referring to the figures. First, the surface of a turbine vane of an IN939 heat resistant alloy product is blasted with Al_2O_3 particles, then a 130 µm metallic bonding layer of Ni-16cr-6Al-0.4Y composite was formed by plasma spraying. Then, a ceramic layer was formed by spray coating ZrO_2-$8Y_2O_3$ to a thickness of 300 µm. Afterward, a dense layer was formed by laser irradiation of the ceramic layer surface section by CO_2 laser spraying. As a result of that, a turbine vane was obtained that had a metallic bonding layer 2 on the surface of a turbine vane 1, a ceramic layer 3, and a ceramic layer 4 with the surface of that made dense.

Also, when the wear resistance of a turbine vane using the abovementioned method was investigated, results were obtained as shown

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in Table Number 1.

Table Number 1

Sprayed Layer	Laser Irradiation Treatment	Oxidation Test 1050°C
NicrAlY/ZrO_2-8Y_2O_3 CocrAlY/ZrO2-8Y_2O_3	Yes	1500 hrs without cracks being produced "
NicrAlY/ZrO_2-8Y_2O_3 CocrAlY/ZrO_2-8Y_2O_3	No	1100 hr with cracks produced 1240 hr with cracks produced

4. Brief Description of the Drawings

Figure Number 1 is a coating cross-sectional diagram of prior [art]. Figure Number 2 is a coating cross-sectional diagram relating to an example of the present invention.

1: turbine vane material, 2: metallic bonding layer, 3: ceramic layer

4: ceramic layer made dense.

Figure Number 1

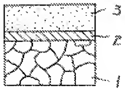

Figure Number 2